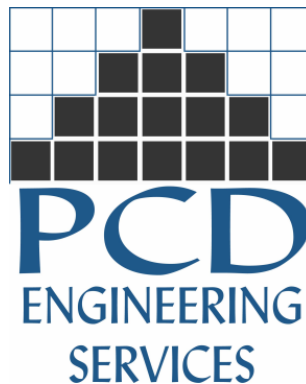


# *Cost and Benefits of Commissioning LEED-NC Buildings*

*Peter C. D'Antonio, LEED AP, PE  
President - PCD Engineering Services, Inc.*

*Consultant under contract to the Governor's Energy Office*



# Background

- ◆ 2006 research project funded by GEO
- ◆ Encompassed 11 LEED-NC certified projects
- ◆ Published white-paper and summary report
- ◆ Included expanded Cx discussion for NCBC



*Governor's*  
**Energy Office**

# Background

- ◆ State Executive Orders and Legislation
  - Energy Performance Contracting to Improve State Facilities
    - Executive Order D-014-03 (July 16, 2003)
  - Greening of State Government,
    - Executive Order D-005-05 (July 15, 2005)
    - Goals and Implementation, EO D0011 07
    - Detailed Implementation, EO D0012 07
  - Greening of State Government Buildings,
    - Senate Joint Resolution 06-032 (May 8, 2006)
    - High Performance Buildings Bill, SB51 (April 26, 2007)
- ◆ City and County Resolutions





# Background



## **Governor's Energy Office:**

- ◆ Supports HPD(LEED)/ESPC/Energy Mgmt (Cx)
  - No-Cost Technical Assistance and Education (State, Higher Ed, K-12)
- ◆ \$500k in high performance design grants
- ◆ Facilitated \$130M in ESPC to-date
- ◆ LEED reports and HPD/ESPC/Cx resources at [www.colorado.gov/rebuildco](http://www.colorado.gov/rebuildco)



# Objectives



## Report Helps Answer:

- ◆ Is LEED-NC cost effective?
- ◆ What does it cost to build a high-performance green building?
- ◆ What is the cost-premium for a LEED-NC certified building?
- ◆ How much should I budget for a LEED-NC building and commissioning of a LEED-NC building?
- ◆ Of the four LEED-NC certification levels available, do certain levels cost more than others to obtain?
- ◆ What are the factors that make some LEED-NC projects cost less than others?
- ◆ Why do some projects cost so much more, and how could costs be better managed in the future?



---

# Cost Basis

---

- ◆ As if building was not constructed to LEED-NC criteria
- ◆ Some teams consider Cx, modeling, and other LEED items as business as usual
- ◆ “*LEED costs too much!*” - Depends on the frame of reference

# Projects At-A-Glance

## 2003

- ◆ CH2M HILL North Building
- ◆ City of Boulder, North Boulder Recreation Center

## 2004

- ◆ CH2M HILL South Building
- ◆ CH2M HILL West Building

**5 CERTIFIED  
5 SILVER  
1 GOLD**

## 2005

- ◆ Aspen Skiing Company, Snowmass Golf Clubhouse
- ◆ Colorado College Tutt Science Center
- ◆ University of Denver Ricketson Law Building
- ◆ Poudre School District, Fossil Ridge High School
- ◆ Colorado Department of Labor & Employment Addition
- ◆ Pikes Peak Regional Development Center
- ◆ City of Fort Collins, Utilities Vehicle Storage



---

# Summary of Findings

---

- Cost premium of 1% to 6%
- Soft costs averaged \$1 per square foot (0.8% of construction costs)
- NPV of energy savings offset LEED costs in 7 of 9 projects reporting energy data.
- Two projects complete within schedule and budget.

# Summary of Findings

LEED-NC v2.1 Project	LEED-NC Certification Level	Building Size [SF]	Year Completed	Construction Cost [\$/SF]	LEED Cost Premium [\$/SF]	NPV Energy Cost Savings [\$/SF]	Net LEED Savings [\$/SF]
Aspen Skiing Company Snowmass Golf Clubhouse	Silver	10,000	2005	\$370	(\$20.00)	no data	
CH2M Hill North Building	Certified	112,600	2003	\$156	(\$1.90)	\$4.30	\$2.40
CH2M Hill South Building	Certified	112,600	2002	\$156	(\$1.90)	\$4.30	\$2.40
CH2M Hill West Building	Certified	164,500	2003	\$156	(\$1.90)	\$4.30	\$2.40
City of Boulder N. Boulder Rec. Center	Silver	62,000	2002	\$188	(\$8.70)	\$10.40	\$1.70
City of Fort Collins Vehicle Storage	Certified	15,250	2005	\$129	(\$8.20)	\$6.70	(\$1.50)
Colorado College Tutt Science Center	Certified	54,123	2004	\$200	(\$9.20)	no data	
Colorado Dept of Labor & Employment Addition	Certified	40,000	2004	\$100	(\$3.30)	\$2.30	(\$1.00)
Pikes Peak Regional Development Center	Silver	111,758	2005	\$112	(\$0.90)	\$5.10	\$4.20
Poudre School District Fossil Ridge HS	Silver	288,685	2004	\$122	(\$1.00)	\$4.00	\$3.00
University of Denver Law Building	Gold	210,000	2003	\$230	(\$0.70)	\$3.50	\$2.80

NPV assumes 6% discount rate over 20 years



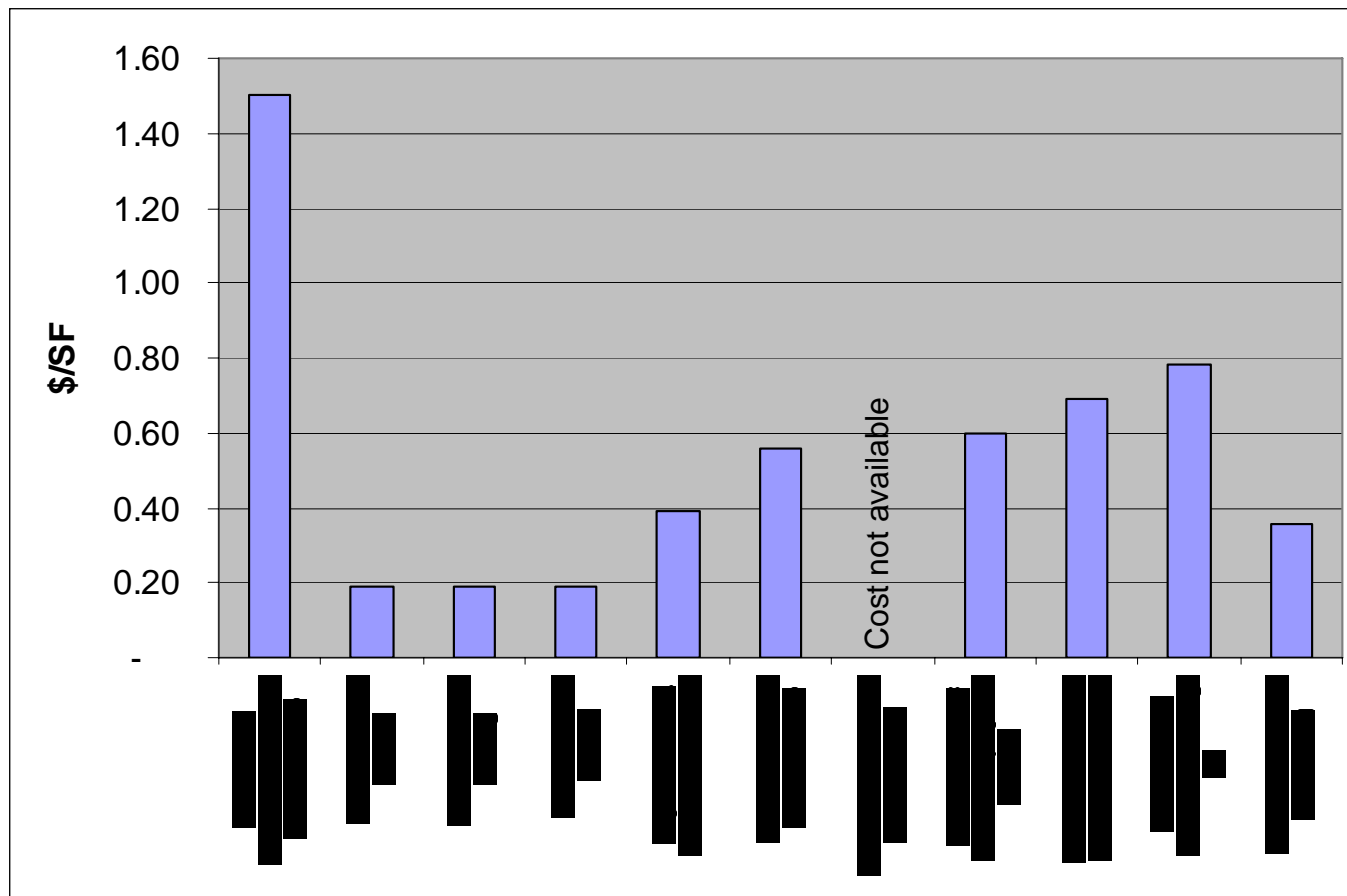
---

## Summary of Findings - Cx

---

- 10 projects reporting data, counting one CH2M Hill building
- All but one project incorporated enhanced Cx
- Cx averaged \$0.55 per square foot
- Cx ranged from \$0.19 to \$1.50 per square foot
- Cx represents ~60% of LEED-NC soft costs

# Summary of Findings – Cx Cost





---

## Summary of Findings - Cx

---

- All but two projects were strong advocates of Cx, however all projects are going to commission again
- Three projects pursue Cx as business as usual due to the perceived return on investment
- Two projects saw Cx costs recovered almost immediately in the design phase through identification of cost savings opportunities

**CH2M HILL**  
**North, West, South Buildings**  
*Englewood, Colorado*



**LEED-NC CERTIFIED**  
v2.1 May 2003  
v2.1 January 2004  
v2.1 Jun 2004

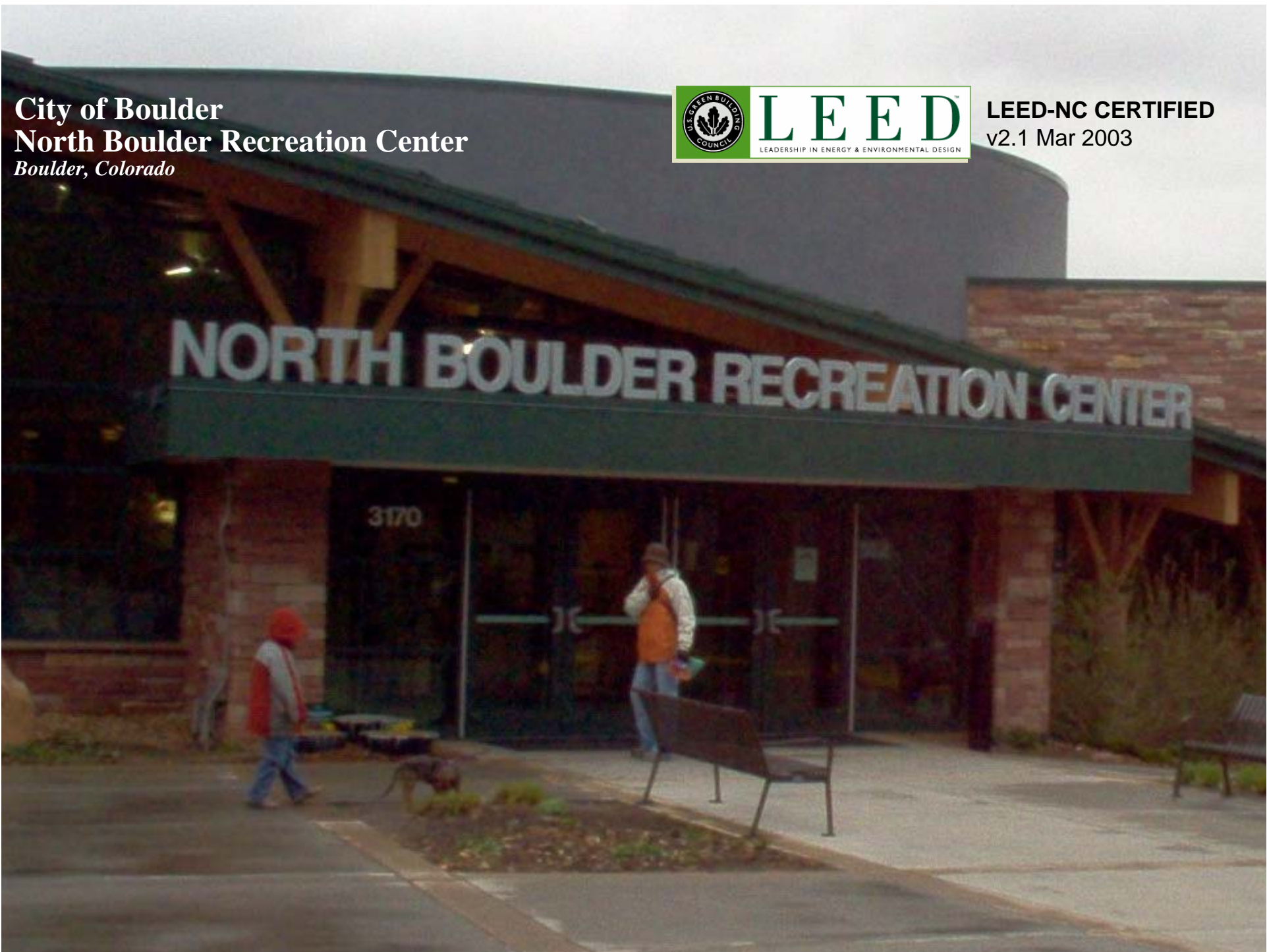
- ◆ Lowest cost per square foot
- ◆ Cx provided by owner
- ◆ Repeatative project type



**City of Boulder**  
**North Boulder Recreation Center**  
*Boulder, Colorado*



**LEED-NC CERTIFIED**  
v2.1 Mar 2003



**City of Boulder**  
**North Boulder Recreation Center**  
*Boulder, Colorado*



- ◆ Predicted energy savings being achieved
- ◆ No unforeseen maintenance issues
- ◆ Cx resulted in more organized documentation and baseline data for ongoing O&M
- ◆ Enhanced Cx to be part of all future projects
- ◆ 2% added to budget to cover added cost of LEED

Aspen Skiing Company  
Snowmass Golf Clubhouse  
*Snowmass, Colorado*



LEED-NC SILVER  
v2.1 2005



**Aspen Skiing Company**  
**Snowmass Golf Clubhouse**  
*Snowmass, Colorado*





Aspen Skiing Company  
Snowmass Golf Clubhouse  
*Snowmass, Colorado*

- ◆ LEED critical because of 3<sup>rd</sup> party stamp of approval, not because drives green design
- ◆ Cx is one of the most important requirements of LEED
- ◆ Commissioning saved 2/3 of their fee during the design stage
- ◆ Commission all projects
- ◆ No impact on project timeline due to LEED
- ◆ Owner feels Cx provided less than 10-year payback

Colorado College  
Tutt Science Center  
*Colorado Springs, Colorado*



LEED-NC CERTIFIED  
v2.1 Mar 2005



**Colorado College**  
**Tutt Science Center**  
*Colorado Springs, Colorado*



- ◆ Life cycle conscious and previously performed in-house testing and balancing
- ◆ Expectations regarding Cx were not met, many controls problems remained
- ◆ Pursuing LEED on their next project and occupant satisfaction is high

**University of Denver**  
**Ricketson Law Building**  
*Denver, Colorado*



**LEED-NC GOLD**  
v2.1 Jun 2005



**University of Denver**  
**Ricketson Law Building**  
*Denver, Colorado*

- ◆ First LEED-NC law school
- ◆ DU has commitment to Cx for all buildings



Poudre School District  
Fossil Ridge High School  
*Fort Collins, Colorado*



LEED-NC SILVER  
v2.1 2005



**Poudre School District  
Fossil Ridge High School**  
*Fort Collins, Colorado*



**Poudre School District  
Fossil Ridge High School**  
*Fort Collins, Colorado*



- ◆ Cx standard practice
- ◆ Frees up maintenance personnel, provides better documentation, accountability, and representation
- ◆ Built within typical construction costs for area schools
- ◆ Delivers \$100,000 energy savings per year

**Colorado Department of  
Labor & Employment Addition**  
*Denver, Colorado*



LEED-NC CERTIFIED  
v2.1 August 2005

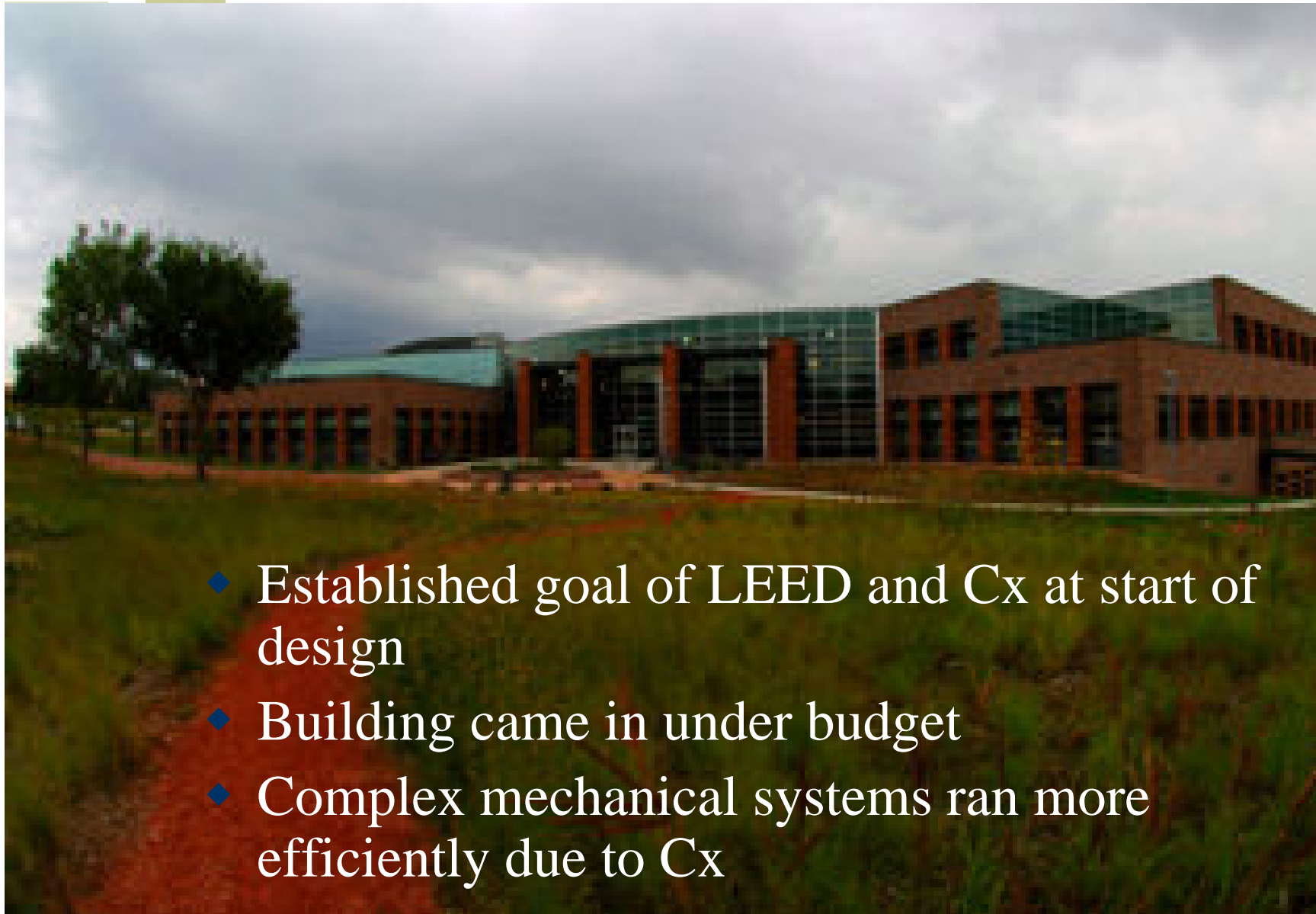


**Colorado Department of  
Labor & Employment Addition**  
*Denver, Colorado*

- ◆ First state-owned LEED certified building
- ◆ Cx gave owner stronger voice
- ◆ Cx now standard on all projects
- ◆ Built within original program, budget & timeline
- ◆ Set goal of LEED during A/E short-list process



**Pikes Peak Regional Development Center**  
*Colorado Springs, Colorado*



- ◆ Established goal of LEED and Cx at start of design
- ◆ Building came in under budget
- ◆ Complex mechanical systems ran more efficiently due to Cx

**Pikes Peak Regional Development Center**  
*Colorado Springs, Colorado*



**Fort Collins Utilities  
Vehicle Storage Building**  
*Fort Collins, Colorado*



LEED-NC SILVER  
v2.1 April 2006

- ◆ Cx too documentation and time intensive
- ◆ LEED Cx documentation was streamlined
- ◆ City Council Resolution requires attempting LEED





# Summary of Conclusions



- ◆ LEED-NC is cost effective
- ◆ The cost-premium for a LEED-NC certified building is 1% to 6%, but the added cost depends on your frame of reference
- ◆ Budget \$.60-\$.80 per square foot for commissioning of a LEED-NC building, more for more complex systems
- ◆ Not enough data was available to determine if certain certification levels cost more than others to obtain
- ◆ Commissioning contributed to the success of all LEED-NC projects



# Areas for Future Research

- ◆ Confirming predicted energy savings – measure effectiveness of Cx
- ◆ Examine benefits beyond energy – Cx O&M, water, productivity
- ◆ Quantify effect of LEED-NC v2.2 regarding changes to Cx  
EA p1

Thank you!

*Peter C. D'Antonio, PE, CEM, LEED AP*  
*PCD Engineering Services, Inc.*  
*[peter@pcdengineering.com](mailto:peter@pcdengineering.com)*  
*(303) 678-1108*

